Understanding the Science Behind Riparian Forest Buffers:

Effects on Water Quality

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Introduction

Over a third of our nation's streams, lakes, and estuaries are impaired by some form of water pollution (U.S. E.P.A. 1998). Pollutants can enter surface waters from **point sources**, such as single source industrial discharges and waste-water treatment plants; however, most pollutants result from **nonpoint source** pollution activities, including runoff from agricultural lands, urban areas, construction and industrial sites, and failed septic tanks. These activities introduce harmful sediments, nutrients, bacteria, organic wastes, chemicals, and metals into surface waters. Damage to streams, lakes, and estuaries from nonpoint source pollution was estimated to be about $7 to $9 billion a year in the mid-1980s (Ribaudo 1986).

Nonpoint source pollution can be difficult to control, measure, and monitor. In most cases, a combination of practices are required to address the problem. This may include the proper application of fertilizers and pesticides or the introduction of practices to reduce stormwater runoff and soil erosion. These practices are commonly known as Best Management Practices (BMPs). One BMP which can be very effective in influencing water quality is the construction of riparian forest buffers along streams, lakes, and other surface waters. Through the interaction of their unique soils, hydrology, and vegetation, riparian forest buffers influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms.

Effects of Riparian Buffers on Sediment, Nutrients, and Other Pollutants

Sediment

Sediment refers to soil particles that enter streams, lakes, and other bodies of water from eroding land, including plowed fields, construction and logging sites, urban areas, and eroding stream banks (Figure 1) (U.S. E.P.A. 1995). Sedimentation of streams can have a pronounced effect on water quality and stream life. Sediment can clog and abrade fish gills, suffocate fish eggs and aquatic insect larvae, and cause fish to modify their feeding and reproductive behaviors. Sediment also interferes with recreational activities as it reduces water clarity and fills in waterbodies. In addition to mineral soil particles, eroding sediments may transport other substances such as plant and animal wastes, nutrients, pesticides, petroleum products, metals, and other compounds that can cause water quality problems (Clark 1985, Neary and others 1988).

Figure 1. Sediment enters surface waters from eroding land, including plowed fields, construction sites, logging sites, urban areas, and eroding streambanks. (photo courtesy Robert Baldwin, Delaware Department of Natural Resources & Environmental Control - Sediment & Stormwater Program)

Studies indicate that both forest and grass riparian buffers can effectively trap sediment. For example:

- Researchers in Blacksburg, Virginia, found that orchard grass filter strips 30 feet wide removed 84 percent of the sediment and soluble solids from surface runoff, while grass strips 15 feet wide reduced sediment loads by 70 percent (Dillaha and others 1989).
- In the Coastal Plain of Maryland, KY31 tall fescue filter strips 15 feet wide reduced sediment losses from croplands by 66 percent (Magette and others 1989).
- In North Carolina, scientists estimated that 84 percent to 90 percent of the sediment from cultivated agricultural fields was trapped in an adjoining deciduous hardwood riparian area (Cooper and others 1987). Sand was deposited along the edge of the riparian forest, while silt and clay were deposited further in the forest.
- Along the Little River in Georgia, scientists found that a riparian forest had accumulated 311,600 to 471,900 pounds per acre of sediment annually over the last 100 years (Lowrance and others 1986).
- Researchers in the Piedmont of North Carolina found that grass and grass-forest filter strips were equally effective in removing sediments, reducing loads from 60 percent to 90 percent (Daniels and Gilliam 1996).

However, researchers have observed that the effectiveness of grass filter strips may decrease over time as the strip becomes inundated with sediment or as the ground becomes saturated with runoff. For example, in an experiment at Virginia Tech, researchers demonstrated that a filter strip which initially removed 90 percent of the sediment was removing only 5 percent of the sediment after six trials (Dillaha and others 1989). Buffers may be most effective at removing large particles such as sand, but may be less effective at removing small clay particles. In Arizona, researchers found that sand particles could be removed by grass buffers within a